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(54) Benzoic acid derivatives.

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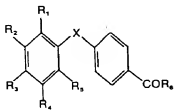

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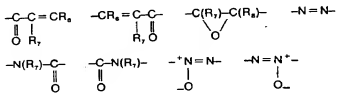

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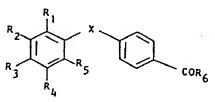

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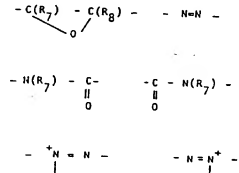
wherein R_1, R_2, R_3, R_4 and R_5 may be the same or different, each represents hydrogen, middle and lower alkyl, and cycloalkyl harring 3 – 7 atoms with proviso each can not be hydrogen simultaneously, and both neighbouring substituents may be combined with each other to form a ring having 5 to 12 carbon atoms, R_6 represents hydroxyl, lower alkoxyl, a group of the formula $-NR_7'R_8'$, wherein R_7' and R_8' each represents hydrogen or lower alkyl, X represents a group of the formula



wherein R_7 and R_8 represent hydrogen or lower alkyl. Furtheron a process to prepare this substances and a method to determ the type of leukemia is described.

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SPECIFICATION

TITLE OF THE INVENTION

BENZOIC ACID DERIVATIVES

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION:

Some chondrogenetic disorders and dermatological disorders such as psoriasis and malignant disorders such as leukemia can be looked upon as a diseases involving a block or an abnormality in differentiation. The present invention relates to novel organic compounds, which have great potential as useful medicaments and which may accordingly be developed and offered for treating the disorders of humans and animals.

Further the compounds of the prevent invention can be used for diagnosis of leukemia.

DESCRIPTION OF THE PRIOR ART:

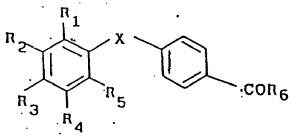
It is already known that an interesting method exists, by which the differentiation is effected and an extinction of cancer cells caused to occur (J. Med. Chem. 25 1269-1277 (1982) with Title: Retinoids at the Threshold: Their Biological Significance and Therapeutic Potential; Cancer Research (Suppl.) 43 2469s-2475s May 1983 with Title: Inhibition of Carcinogenesis by Retinoids; BLOOD of J.A.S. of Hematology 62 709-721 (1983) with Title: Induction of Differentiation of Human Acute Myelogenous Leukemia Cell. Therapeutic Implications; Experientia

1105-1246 1978 with Title: Retinoids, a new class of compounds with prophylactic and therapeutic activities in oncology and dermatology and Cell Technology 2, No.12 (1983)). These Literatures report also that retinoic acid, retinoids and related compounds have significant therapeutic potential in oncology and dermatology.

In the specification of DOS 28 54 354, it is reported that stilbene derivatives such as p-((E)-2-(5,6,7,8-tetrahydro-5,5,8,8-tetramethyl-2-naphthyl)propenyl)benzoic acid are pharmacologically valuable and useful for systemic and topical treatment and prophylaxis of benign or malignant tumors. These compounds and retinoids are said to be suitable for systemic and topical treatment of acne, psoriasis and precancerous conditions and of other dermatopathy which is accompanied by a hyperkeratinization as well as other pathologic and allergic dermatological disease.

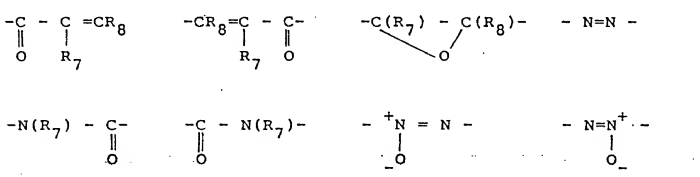
DETAILED DESCRIPTION OF THE THE INVENTION:

It has now been found that the benzoic acids of the formula (I):



(I)

wherein R_1, R_2, R_3, R_4 and R_5 may be the same or different, each represents hydrogen, middle and lower alkyl and/or cycloalkyl having 3 to 7 atoms, with the proviso each can not be hydrogen simultaneously, and both neighboring substituents may be combined with each other to form a ring having 5 to 12 carbon atoms, R_6 represents hydroxyl, lower alkoxyl, lower alkylamino of the formula $-NR_7'R_8'$, wherein R_7' and R_8' each represent hydrogen or lower alkyl, X represents a group of the formula:

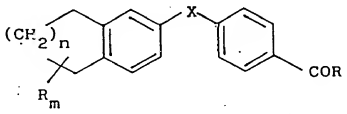


wherein R_7 and R_8 represent hydrogen or lower alkyl, are capable of inducing the differentiation of premalignant and malignant cells, especially leukemia cells, to morphologically and functionally mature cells which cannot proliferate further, and can therefore be used in the therapy of premalignant and malignant diseases of humans and animals.

By the term "lower" in formula I is meant a straight or branched carbon chain having 1-6 carbon atoms. Therefore, the lower alkyl moiety of the lower alkyl, lower alkoxy, and lower alkylamino group encompassed by R_1, R_2, R_3, R_4 and R_5 is representatively methyl, ethyl, propyl, isopropyl, butyl, sec-butyl, tert-butyl, etc. The lower alkoxy moiety of the lower

alkoxy group is representatively methoxy, ethoxy, propoxy, butoxy, etc., and the lower alkylamino group is representatively mono- or dimethyl-amino, mono- or diethylamino, etc. By cycloalkyl there is representatively intended cyclopropyl, cyclobutyl, cyclopentyl, methylcyclopropyl, cyclohexyl and the like.

When the neighboring substituents combine to form a ring, together with two carbon atoms of phenyl group, the compound can be shown, for example, as following general formula



whereby R means a lower alkylgroup, n is 1-3 and m is 1-5.

The compounds of above-shown general formula I provided by this invention form salts with bases. This invention includes the pharmaceutically acceptable salts of the compounds of general formula I and examples of these salts are the salts with alkali metals such as sodium, potassium, etc., or alkaline earth metals such as calcium, etc.; the salts with ammonia; and the salts with organic bases such as methylamine, ethylamine, diethylamine, trimethylamine, triethylamine, pyridine, picoline, arginine, lysine, etc.

The compounds of this invention have been tested according to established test procedure which shows the differentiation of malignant cells, whereby the differentiation of human acute promyelocytic leukemia cells (HL-60) and their conversion to

mature granulocytes (myelocyts) can be assayed by an observation of the morphological changes of nuclei and further by the measurement of the degree of reduction of nitro-blue tetrazolium (NBT) which is induced by a test compound (Proc. Natl. Acad. Sci. USA 77, 2936-2940 (1980) with Title: Induction of differentiation of the human promyelocytic leukemia cell line (HL-60) by retinoic acid).

The HL-60 cell are cultured in plastic flasks in RPMI-1640 medium supplemented with 5 % heat inactivated fetal calf serum and antibiotics (penicillin G and streptomycin). The cells (3 x 10^4 /ml) were cultured with a compound of the present invention for 4 days. Growth inhibition of the cells by the test compounds was determined by counting the number of cells by microscope and relative ratio was examined by taking the number of cells by control (without test compound) as 100 %. The cells are fixed and stained with Wright-Giemsa to examine the morphological changes of the nuclei.

The cells treated with the present compounds are differentiated to mature granulocytes (myelocytes, metamyelocytes and neutrophiles), just as the cells treated with retinoic acid.

The biochemical activity of cells treated with the compound was measured as follows:

The cells after 5 days incuvation are centrifuged and diluted with RPMI-1640 medium supplemented with 5 % fetal calf serum, to provide a definite number of the cells. To the diluted cell susupension are then added 200 ng/ml of 12-O-tetradodecanoylphorbol-13-acetate (TPA) and the resulting culture medium is

hen incubated for 20 minutes at 37°C in the presence of 0.1% of BT. Thus, the mature differentiated cells containing blue-black ormazan is counted by microscopy, so that the ratio of the ells having the ability to reduce NBT, to total cells, can be alculated.

The cells treated with the compound of this invention show the NBT reduction activity which corresponds to the important biochemical activity of differentiated cells.

The results of the tests according to the above mentioned methods are summarized in Table 1.

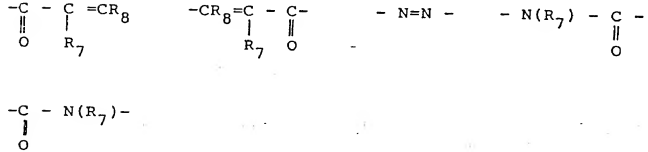
As can be seen from the results shown in Table 1 the activity of the compounds of this invention is observed at a concentration less than 10^{-6} Mol.

The alkyl-substitution R_1, R_2, R_3, R_4 and R_5 on the phenyl group in the formula (I) is a characteristic of the benzoic acids and their derivatives which are the compounds of this invention. Such a compound, wherein the alkyl group is a middle alkyl group, especially wherein one alkyl substituent is an isopropyl, cyclopropyl, cyclobutyl, or butyl group, or wherein two or more substituents are ethyl, isopropyl or tert-butyl group, is effective. On the other hand such a compound, wherein all of R_1 - R_5 are hydrogen, does not exhibit the desired activity.

The most impotant alkyl substituents are R_2, R_3 and R_4. The compounds, wherein two alkyl substituents R_2 and R_3 are combined to form a ring, are most important.

The compounds of the formula (I), wherein R_7 and R_8 represent hydrogen or methyl are especially effective.

The most important X-group are



Several compounds of the formula (I), wherein X means, SO_2NH-, -O·CO-, -COO-, -NHCONH-, -NHCOO- and -O·SO_2- as equivalent substituents, have been synthesised and tested.

These compoundscan be used as diagnosis for determining the type of leukemia by a measuring method, whereby the blood of a patient with leukemia is incubated in vitoro in the presence of a present compound in an nalogious manner as described in the morphological assay for the HL-60 cells: Only promyelocytic leukemia cells, but not lymphocytic leukemia cells, differentiate to mature granulocytes, which can be clearly determined by microscope (See: Saibo (Cells) 14,533 (1982)).

When the incubation is performed in a soft agar, promyelocytic leukemia cells do not form a colony, since the differentiated cells do not proliferate further.

Thus, these compounds are very useful in the determination of promyelocytic leukemia, which enables to select the therapentical methods.

At the same time the compounds of this invention are very usefull as reagents for research of leukemia.

A test of treatment of nude mice, to which HL-60 have been transplanted, with a compound of the present invention is performed as follows:

A test compound (e.g., p-(5,6,7,8-tetrahydro-5,5,8,8-tetramethyl-2-naphthylcarbamoyl)benzoic acid) is suspended in 10% (v/v) Tween 80 in a concentration of 10 mg/ml. Cells (5×10^7) of HL-60 were transplanted subcutaneously to a nude mouse (BALB/c, nu/nu female Nihon Clea).

At the days 9, 14 and 17 after the transplantation, 0.1 ml of the suspension per 10 g of body weight of mouse were administrated per os two times at intervals of 7 hours (200 mg/kg/day). Tumor volume measurements at every 4, 6, 8 and 11 day after the first administration show that tumor growth was clearly suppressed; The increases of tumor volume of the treated mice are 1/5 - 1/2 compared with the untreated mice.

Since the compounds of the present invention differentiate the leukemia cells to mature granulocytes morphologically and functionally and inhibit the cell-growth potentially, they can be used as medicine for treatment of humans and animals with cancer.

Thus, it was demonstrated that the compounds of the present invention have remarkable anticancer-antileukemic activity, when tested on nude mice transplanted with human-derived leukemia cells. These facts also suggest that a compound of this invention effective against neuroblastoma, squamous cell carcinoma, and melanoma.

These compounds suppress the hyperkera keratinization of human tissue cells, and are useful for the treatment of cystic acne, psoriasis and related cutaneous disorders of keratinization and of epithelial differentiation.

The medical compositions containing the compounds of this invention as the main component are formulated in a conventional manner using conventional carriers for formulation and excipients. The medicaments may be administered orally as tablets, pills, capsules, granules, etc., or may be administered parenterally as injections such as intraveous injections, intramuscular injections, etc., in the form of ointments, creams and the like for external application in particular for the treatment of dermatological disorders. They may be used as aerosols, suppositories, etc. The doses of the medicaments are properly determined according to each case on considering the symptom, the age of patient, sex distinction, etc., but are usually 1-300 mg per day for an adult in case of oral administration and 1-100 mg per day for an adult in case of parenteral administration, the daily amount usually being administered in 2-3 separate dosages.

The compounds represented by the formula (I) can be prepared by the following method:

(a) a compound represented by the formula (I), wherein X represents a group of the formula $-CO-C(R_7)=CR_8-$, is prepared by condensation of a corresponding acetophenone derivative with a terephthalaldehyde acid ester or a derivative in the presence of a base,

(b) a compound represented by the formula (I), wherein X represents a group of the formula: $-C(R_7)-C(R_8)-$ (with O bridging the two carbons)

is prepared by oxidation of a corresponding compound, wherein X represents a group of the formula:

$$-C(R_7) = C(R_8)-$$

with a reagent for epoxidation.

(c) a compound represented by the formula (I), wherein X represents a group of the formula -N=N-, is prepared by condensation of a corresponding aniline derivative with a p-nitroso-benzoic acid in the presence or absence of an acidic catalyst,

(d) a compound represented by the formula (I), wherein X represents a group of the formula -N(O)=N- or -N=N(O)-, is prepared by condensation of a corresponding phenyl-hydroxylamine with a p-nitro-benzoic acid or a derivative, as described in item (c),

(e) a compound represented by the formula (I), wherein X represents a group of the formula -N=N(O)- or -N(O)=N-, is prepared by condensation of a nitrosobenzene derivative with a p-hydroxyl -amino benzoic acid or a derivative thereof, as described in item (c),

(f) a compound represented by the formula (I), wherein X represents a group of the formula $-N(R_7)-CO-$, is prepared by acylation of a corresponding aniline derivative with a functional derivative of terephthalic acid (acid halogenide or ester of the acid), and

(g) a compound represented by the formula (I), wherein X represents a group of the formula $-CO-N(R_7)-$, is prepared by acylation of a p-amino benzoic acid or a derivative thereof with a functional derivative of a corresponding benzoic acid in the usual manner and, if necessary or desirable, the thus obtained compound is hydrolized.

The following examples are given by way illustration only and are not to be construded as limitations of this invention.

Example 1

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To a solution of 176 mg (1 mmole) of p-tert.-butyl acetophenone and 164 mg (1 mmole) of terephthalic aldehyde acid methyl ester in 8 ml of ethanol was added 10 ml of 1N

sodium hydroxide and the reaction mixture was stirred at room temperature for one night. After completion of the reaction, the reaction solution was acidified with dil. hydrochloric acid followed by extraction with ethyl acetate. The extracted solution was washed with water until the pH of the washing became 7 and dried over anhydrous sodium sulfate.

After removing the solvent by distillation, the objective compound of the formula (I), wherein R_3 means t-butyl :X means a group of the formula: -COCH=CH- and R_6 means hydroxyl group, and R_1, R_2, R_4 and R_5 are hydrogen having a melting point of 245 - 246°C were obtained. (yield; 75.2 %)

Elemental Analysis for $C_{20}H_{20}O_3$

Calcd. (%): C; 77.90, H; 6.54

Found (%): C; 77.62, H; 6.43.

To a solution of the thus obtained carboxylic acid in methanol was added a solution of diazomethane in ether to obtain quantitatively the methyl ester having a melting point of 119 - 120.5°C.

Example 2

A solution of 100 mg (0.287 mmole) of p-(E)-2-(5,6,7,8-tetrahydro-5,5,8,8-tetramethyl-2-naphthyl)ethenyl benzoic acid methyl ester in 5 ml of chloroform was added to a solution of 50 mg (0.289 mmole) of m-chloroperoxybenzoic

acid in chloroform and the mixture was refluxed for two hours. After disappearance of the raw materials, the reaction solution was cooled and the insoluble materials were removed with filtration. The solution was washed successively with 1N aq. sodium carbonate solution, 1N aq. sodium bicarbonate solution and saturated aq. saline solution, it was dried over anhydrous sodium sulfate. The distillation of the solvent gave an epoxy compound represented by the formula (I), wherein R_2 and R_3 mean a group of the formula: $-C(CH_3)_2CH_2CH_2C(CH_3)_2-$ and X means a group of the formula: $-CH-CH-$ (with O) and R_6 means methoxy, and R_1, R_4 and R_5 are hydrogen, which has a melting point of 163 - 166°C. (yield: 92.0 %)

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After hydrolysis of the epoxy compound (ester) thus obtained with 1N solution of sodium hydroxide in ethanol and neutralization with hydrochloric acid, the resulting solution was extracted with ethyl acetate. The solvent was removed by distillation and the residue was recrystallized from ethyl acetate to obtain the corresponding carboxylic acid having a melting point of 215 - 216°C.

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Elemental Analysis for $C_{23}H_{26}O_3$

Calcd. (%): C; 78.82, H; 7.48

Found (%): C; 79.03, H; 7.74.

Example 3

The nitration of 1.2 g of 5,5,8,8-tetramethyl-5,6,7,8-tetrahydronaphthalene with nitric acid/sulfuric acid mixture in sulfuric acid gave a 2-nitro derivative having a melting point of 71 - 72°C (0.9 g, recrystallized from methanol). The reduction of the obtained nitro derivative with Pd-C as catalyst in alcohol gave 2-amino-5,6,7,8-tetrahydro-5,5,8,8-tetramethyl-naphthalene having a melting point of 72 - 73°C (recrystallized from hexane).

To a solution of 0.2 g of the thus obtained amino compound in 10 ml of acetic acid was added 0.1 g of trichloroacetic acid and the solution was mixed with a slight exess of 4-nitrosc benzoic acid methyl ester and allowed to stand at room temperature for two hours. The solvent was removed by distillation and the resulting product was recrystallized from methanol to yield 0.32 g of the azo-compound of the formula (I), wherein R_2 and R_3 mean a group of the formula: $-C(CH_3)_2CH_2CH_2C(CH_3)_2-$, R_6 means methoxy and X means a group of the formula: -N=N-, and R_1, R_4 and R_5 are hydrogen, which has a melting point of 118.5 - 119.5°C.

Elemental Analysis for $C_{22}H_{26}N_2O_2$

Calcd. (%): C; 75.40, H; 7.48, N; 7.99

Found (%): C; 75.28, H; 7.29, N; 7.81.

A hydrolysis of the thus obtained azo-compound in methanol with 1N sodium hydroxide and the treatment described in Example 2 gave the corresponding carboxylic acid having a melting point of 287 - 288°C.

Example 4

100 mg of nitro-compound obtained in example 3 dissolved in 30 ml of wet tetrahydrofuran was reduced with aluminum amalgam (prepared from 300 mg of aluminum foil and 30 ml of 5 % aqueous solution of $HgCl_2$) to yield the coresponding hydroxylamine derivative, which was, without purification, reacted with a slight excess of p-nitroso benzoic acid methyl ester to give an azoxy derivative having the formula (I): wherein R_2 and R_3 mean a group shown by the formula: $-C(CH_3)_2CH_2CH_2C(CH_3)_2-$, R_6 means methoxy and X is a group of the formula: -N=N(O)-, and R_1, R_4 and R_5 are hydrogen, having a melting point of 114 - 115°C (recrystallized from hexane). MASS: M^+ =366.

Example 5

1 mmole of 2-amino-5,6,7,8-tetrahydro-5,5,8,8-tetramethyl naphthalene obtained in Example 3 was reacted with 1.1 mmole of terephthalic acid chloride monomethyl ester in pyridine at room temperature to quantitatively obtain a compound of the formula (I),
wherein R_2 and R_3 means a group of the formula:
$-C(CH_3)_2CH_2CH_2-C(CH_3)_2-$, X means a group of the formula -NH-CO- and R_6 means methoxy, and R_1, R_4 and R_5 are hydrogen, which was recrystallized from methylene chloride / hexane.
m.p. 211 - 212°C.

A solution of the thus obtained compound in methanol was reacted with 1N sodium hydroxide for two hours at room temperature, whereafter the solution was neutralized with dilute hydrochloric acid and extracted with ethyl acetate.

The solvent was removed by distillation to give crystals. A recrystallization of the crystals from ethyl acetate / hexane gave a terephthalic acid amide derivative of the formula (I), wherein R_2 and R_3 mean a group of the formula:
$-C(CH_3)_3CH_2CH_2C(CH_3)_2-$, X means a group of the formula : -NH-CO- and R_6 means hydroxyl, and R_1, R_4 and R_5 are hydrogen.
m.p. 205.5 - 206.5°C.

The acid was converted in the usual manner to the ammonium salt having a melting point of 145 - 146°C.

Example 6

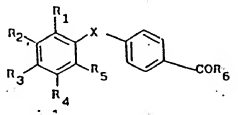
1.1 mmole of 3,4-diethyl benzoic acid chloride was reacted with 1 mmole of 4-amino benzoic acid methyl ester in 10 ml of anhydrous pyridine for five hours at room temperature. After addition of water, the reaction solution was extracted with chloroform, and the extract was washed with dilute hydrochloric acid and water. After removing the solvent by distillation, the resulting residue was recrystallized from methanol to obtain a compound represented by formula (I), wherein R_2 and R_3 each mean an ethyl group, X means a group having the formula: -CO-NH- and R_6 means a methoxy group, and R_1, R_4 and R_5 are hydrogen, having a melting point of 162 - 165° C. The yield was quantitative.

A number of compounds were synthesized by the same methods. The compounds of No. 1 to 68 (including the compounds obtained in the above Examples) are surmmarized in Table I.

Table 1

Compound							Concent. (%)	Promyelocytes (%)	Myelocytes and Metamyelocytes (%)	Banded and Segmented Neutrophils (%)	Reductivity of NBT (%)	Growth inhibitation Of cells (%)
R_1	R_2	R_3	R_4	R_5	R_6	X						
Blank							-	98	2	0	1	100
H	H	tBu	H	H	OH	-C(=O)-CH=CH-	10^{-9}	46	48	6	68	7
H	Et	Et	H	H	OCH_3	"	10^{-8}	38	54	8	72	20
H	$-(CH_3)_2CCH_2$ $-(CH_3)_2CCH_2$		H	H	OH	"	10^{-10}	2	86	12	95	11
H	"		H	H	OCH_3	"	10^{-9}	5	91	4	97	10
H	tBu	H	tBu	H	OH	"	10^{-10}	2	82	16	95	5
H	tBu	H	H	H	OCH_3	-CH(O)-CH-	10^{-8}	20	69	9	70	20
H	$-(CH_3)_2CCH_2$ $-(CH_3)_2CCH_2$		H	H	OCH_3	"	10^{-8}	19	63	18	78	18
"	"		"	"	"	-C(CH$_3$)(O)-CH-	10^{-8}	12	79	9	81	18
"	"		"	"	"	-N=N-	10^{-9}	41	49	10	60	12
H	i-Pr	i-Pr	H	H	OH	"	10^{-8}	39	50	11	55	21
H	$-(CH_3)_2CCH_2$ $-(CH_3)_2CCH_2$		H	H	OH	$-N^+(O^-)=N-$	10^{-8}	40	53	7	70	17
"	"		"	"	"	-NH-CO-	10^{-10}	3	78	19	98	6
"	"		"	"	OCH_3	"	10^{-9}	3	85	12	97	10
H	i-Pr	i-Pr	H	H	OH	"	10^{-8}	7	82	11	90	21
Retinoic acid							10^{-7}	25	71	4	75	32

Table 2



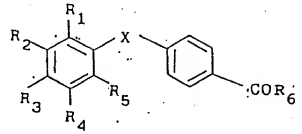
No.	R_1	R_2	R_3	R_4	R_5	R_6	X	Anal	mp	synthesis
1	H	$-(CH_3)_2CCH_2$	$-(CH_3)_2CCH_2$	H	H	OH	$-C(CH_3)_2-CH-$ (O)	$C_{24}H_{28}O_3$	202.5-203.5	b
2	H	"		H	H	OCH_3	"	$C_{25}H_{30}O_3$	137.5-139	b
3	H	i-Pr	i-Pr	H	H	OCH_3	"	$C_{23}H_{28}O_3$	112-113	b
4	H	Et	Et	H	H	OH	"	$C_{20}H_{22}O_3$	146-148	b
5	H	Et	Et	H	H	OH	$-C(=O)-CH=CH-$	$C_{20}H_{20}O_3$	178.5-180	a
6	H	i-Pr	i-Pr	H	H	OH	"	$C_{22}H_{24}O_3$	197.5-199	a
7	tBu	H	H	tBu	H	OH	"	$C_{24}H_{28}O_3$	215-216	a
8	H	tBu	H	tBu	H	OH	"	$C_{24}H_{28}O_3$	202-203.5	a
9	H	H	tBu	H	H	OH	"	$C_{20}H_{20}O_3$	245-246	a
10	"	"	"	"	"	OCH_3	"	$C_{21}H_{22}O_3$	119-120.5	a
11	H	$-(CH_3)_2CCH_2$	$-(CH_3)_2CCH_2$	H	H	OH	"	$C_{24}H_{26}O_3$	203-204	a
12	"	"		"	"	O-n-Bu	"	$C_{28}H_{34}O_3$	128-129.5	a
13	"	"		"	"	OCH_3	"	$C_{25}H_{28}O_3$	93.5-94	a
14	"	"		"	"	NH_2	"	$C_{24}H_{27}O_2N$	208.5-209	a
15	H	Et	Et	H	H	OH	$-NH-C(=O)-$	$C_{18}H_{19}NO_3 \cdot \frac{1}{8}H_2O$	259.5-260.5	f
16	H	H	i-Pr	H	H	OH	"	$C_{17}H_{17}NO_3$	> 300	f
17	H	i-Pr	H	H	H	OH	"	$C_{17}H_{17}NO_3$	103.5-105	f
18	"	"	"	"	"	OCH_3	"	$C_{18}H_{19}NO_3$	104-106	f
19	i-Pr	H	H	H	H	OH	"	$C_{17}H_{17}NO_3$	269.5-271	f
20	"	"	"	"	"	OCH_3	"	$C_{18}H_{19}NO_3$	165.5-167.5	f
21	H	tBu	H	H	H	OH	"	$C_{18}H_{19}NO_3$	Amorph	f
22	i-Pr	H	H	H	i-Pr	OH	"	$C_{20}H_{23}NO_3 \cdot \frac{1}{4}H_2O$	> 300	f
23	"	"	"	"	"	OCH_3	"	$C_{21}H_{25}NO_3$	292-293	f
24	i-Pr	H	H	i-Pr	H	OH	"	$C_{20}H_{23}NO_3$	230-231.5	f
25	"	"	"	"	"	OCH_3	"	$C_{21}H_{25}NO_3$	183-184.5	f
26	i-Pr	H	i-Pr	H	H	OH	"	$C_{20}H_{23}NO_3 \cdot \frac{1}{4}H_2O$	244.5-246	f
27	"	"	"	"	"	OCH_3	"	$C_{21}H_{25}NO_3$	165-166.5	f
28	H	i-Pr	H	i-Pr	H	OH	"	$C_{20}H_{23}NO_3$	256.5-258.5	f
29	"	"	"	"	"	OCH_3	"	$C_{21}H_{25}NO_3$	151-152	f
30	H	i-Pr	i-Pr	H	H	OH	"	$C_{20}H_{23}NO_3$	220.5-221.5	f
31	"	"	"	"	"	OCH_3	"	$C_{21}H_{25}NO_3$	137.5-138	f

No.	R_1	R_2	R_3	R_4	R_5	R_6	X	Anal	mp	synthesis
32	H	cyclo hexyl-	H	H	H	OH	-NH-C- (=O)	$C_{20}H_{21}NO_3$	237-237.5	f
33	"	"	"	"	"	OCH_3	"	$C_{21}H_{23}NO_3$	157-158	f
34	H	$-(CH_3)_2CCH_2$ $-(CH_3)_2CCH_2$	H	H	H	OCH_3	"	$C_{23}H_{27}NO_3$	211-212	f
35	H	"	"	H	H	OH	"	$C_{22}H_{25}NO_3$	205.5-206.5	f
36	H	Et	Et	H	H	OCH_3	"	$C_{19}H_{21}NO_3$	122-123	f
37	H	H	tBu	H	H	OCH_3	"	$C_{19}H_{21}NO_3$	182-183	f
38	"	"	i-Pr	"	"	"	"	$C_{18}H_{19}NO_3$	200-202	f
39	H	tBu	H	H	H	"	"	$C_{19}H_{21}NO_3$	143.5-145	f
40	"	C_5H_9	"	"	"	"	"	$C_{20}H_{21}NO_3$	Amorph	f
41	H	Et	H	H	H	OH	-N=N-	$C_{15}H_{14}N_2O_2$	191.5-192	c
42	H	H	i-Pr	H	H	OH	"	$C_{16}H_{16}N_2O_2$	266.5-268.5	c
43	H	i-Pr	H	H	H	OH	"	$C_{16}H_{16}N_2O_2$	186.5-188.5	c
44	i-Pr	H	H	H	H	OH	"	$C_{16}H_{16}N_2O_2$	195.5-197	c
45	H	tBu	H	H	H	OH	"	$C_{17}H_{18}N_2O_2$	245-246	c
46	i-Pr	H	H	H	i-Pr	OH	"	$C_{19}H_{22}N_2O_2$	Amorph	c
47	i-Pr	H	H	i-Pr	H	OH	"	$C_{19}H_{22}N_2O_2$	192.5-193	c
48	i-Pr	H	i-Pr	H	H	OH	"	$C_{19}H_{22}N_2O_2$	206-208	c
49	H	i-Pr	H	i-Pr	H	OH	"	$C_{19}H_{22}N_2O_2$	201-203	c
50	H	i-Pr	i-Pr	H	H	OH	"	$C_{19}H_{22}N_2O_2$	230.5-232	c
51	H	cyclo hexyl-	H	H	H	OH	"	$C_{19}H_{20}N_2O_2$	248-248.5	c
52	H	CH_3	H	H	H	OCH_3	"	$C_{15}H_{14}N_2O_2$	115-116.5	c
53	"	"	"	"	"	OH	"	$C_{14}H_{12}N_2O_2$	191-193.5	c
54	H	H	i-Pr	H	H	OCH_3	"	$C_{17}H_{18}N_2O_2$	91.5-92	c
55	H	Et	Et	H	H	OCH_3	"	$C_{18}H_{20}N_2O_2$	44-44.5	c
56	"	"	"	"	"	OH	"	$C_{17}H_{18}N_2O_2$	215-216	c
57	H	$-(CH_3)_2CCH_2$ $-(CH_3)_2CCH_2$	H	H	H	OCH_3	"	$C_{22}H_{26}N_2O_2$	118.5-119.5	c
58	"	"	"	"	"	OH	"	$C_{21}H_{24}N_2O_2$	287-288	c
59	H	tBu	H	H	H	OCH_3	"	$C_{18}H_{20}N_2O_2$	104-105	c
60	H	$-(CH_3)_2CCH_2$ $-(CH_3)_2CCH_2$	H	H	H	OCH_3	-C-CH- (H, O)	$C_{24}H_{28}O_3$	163-166	b
61	"	"	"	"	"	OH	"	$C_{23}H_{26}O_3$	215-216	b
62	H	tBu	H	H	H	OH	"	$C_{19}H_{20}O_3 \cdot \frac{1}{6}H_2O$	199-200.5	b
63	H	$-(CH_3)_2CCH_2$ $-(CH_3)_2CCH_2$	H	H	H	OCH_3	$-\overset{+}{N}=N-O^-$	$C_{22}H_{26}N_2O_3$	114-115	d,e

No.	R_1	R_2	R_3	R_4	R_5	R_6	X	Anal	mp	synthesis
64	H	$-(CH_3)_2CCH_2$	$-(CH_3)_2CCH_2$	H	H	OCH_3	$-N(CH_3)-CO-$	$C_{24}H_{29}NO_3$	117-118	f
65	H	Et	Et	H	H	OCH_3	-CO-NH-	$C_{19}H_{21}NO_3$	162-165	g
66	H	H	tBu	H	H	OH	-CH(O)-CH-	$C_{19}H_{20}O_3$	207-207.5	b
67	H	$-(CH_3)_2CCH_2$	$-(CH_3)_2CCH_2$	H	H	OCH_3	-CO-NH-	$C_{23}H_{27}NO_3$	206-207	g
68	H	"		H	H	OH	"	$C_{22}H_{25}NO_3$	265-267	g

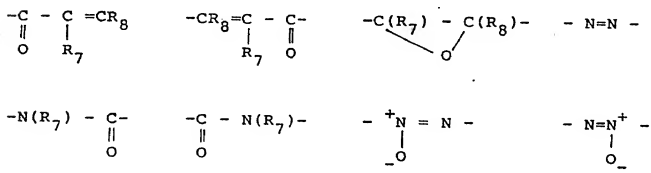
WHAT IS CLAIMED IS:

(1) A benzoic acid derivative represented by the formula (I):



(I)

wherein R_1, R_2, R_3, R_4 and R_5 may be the same or different, each represents hydrogen, middle and lower alkyl, and cycloalkyl harring 3 -7 atoms with proviso each can not be hydrogen simultaneously, and both neighboring substituents may be combined with each other to form a ring having 5 to 12 carbon atoms, R_6 represents hydroxyl, lower alkoxyl, a group of the formula $-NR_7'R_8'$, wherein R_7' and R_8' each represents hydrogen or lower alkyl, X represents a group of the formula



wherein R_7 and R_8 represent hydrogen or lower alkyl.

(2) p-(5,6,7,8-tetrahydro-5,5,8,8-tetramethyl-2-naphthylcarbamoyl)benzoic acid.

(3) 3',5'-Di-tert-butyl-4-carboxychalcone.

(4) p-(5,6,7,8-tetrahydro-5,5,8,8-tetramethyl-2-naphthalen carboxyamid)benzoic acid.

(5) Methyl p-(5,6,7,8-tetrahydro-5,5,8,8-tetramethyl-2-naphthyl)azobenzoate.

(6) 1-(5,6,7,8-tetrahydro-5,5,8,8-tetramethyl-2-naphthyl)-2-4-(methoxycarbonylphenyl)ethylene oxide.

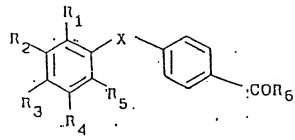
(7) p-(3,4-diisopropylphenylcarbamoyl)benzoic acid.

(8) A differentiation-inducing agent for neoplastic cells, especially leukemia cells comprising as active ingredient one or more benzoic acids of claim 1.

(9) Method for diagnosis to determe the type of leukemia which comprises the incubation of the blood of a patient with leukemia in vitro in the presence of a compound of claim 1, and the observation of morphological changes and / or of colony formation of the leukemia cell.

(10) Use of one or more benzoic acids of claim 1 as a method for treatment of human or animal leukemia which comprises administring an effective amount of a compound of claim 1.

(11) A process for preparation of a benzoic acid derivative represented by the formula (I) :



(I)

wherein R_1, R_2, R_3, R_4, R_5, R_6 and X are as defined in claim 1, comprising the step of;

(a) a compound represented by the formula (I), wherein X represents a group of the formula $-CO-C(R_7)=CH_8-$, is prepared by condensation of a corresponding acetophenone derivative with a terephthalaldehyde acid ester or its derivative in the presence of a base,

(b) a compound represented by the formula (I), wherein X represents a group of the formula $-C(R_7)-C(R_8)-$ (with O) is prepared by oxidation of a corresponding compound, wherein X represents a group of the formula

$$-C(R_7) = C(R_8)-$$

with an agent for epoxidation,

(c) a compound represented by the formula (I), wherein X represents a group of the formula -N=N-, is prepared by condensation of a corresponding aniline derivative with a p-nitroso-benzoic acid ester in the presence or absence of an acidic catalyst,

(d) a compound represented by the formula (I), wherein X represents a group of the formula -N(O)=N- or -N=N(O)-, is prepared by condensation of a corresponding phenyl-hydroxylamine with a p-nitroso-benzoic acid or its derivative, as described in item (c),

(e) a compound represented by the formula (I), wherein X represents a group of the formula -N=N(O)- or -N(O)=N-, is prepared by condensation of a nitroso benzene derivative with p-hydroxylamino benzoic acid or its derivative, as described in item (c),

(f) a compound represented by the formula (I), wherein X represents a group of the formula $-N(R_7)-CO-$, is prepared by acylation of a corresponding aniline derivative with a functional derivative of terephthalic acid (acid halogemide or ester of the acid), and

(g) a compound represented by the formula (I), wherein X represents a group of the formula $-CO-N(R_7)-$, is prepared by acylation of a p-amino benzoic acid or its derivative with a

functional derivative of a corresponding benzoic acid (acid halogenide or ester thereof) in the usual manner and, if necessary or desirable, the obtained compound is hydrolized.

European Patent Office

PARTIAL EUROPEAN SEARCH REPORT

which under Rule 45 of the European Patent Convention shall be considered, for the purposes of subsequent proceedings, as the European search report

Application number: 0170105
EP 85 10 8383

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	GB-A- 1 566 497 (BIOREX LABORATORIES) * Claims 1,26,32,33; page 11, lines 86-115; page 12, lines 41-45 * ---	1,8,10, 11	C 07 C 65/38 C 07 C 65/40 C 07 C 69/76 C 07 D 303/16 C 07 C 107/06 C 07 C 125/067 C 07 C 105/00
X	FR-A- 2 172 868 (PIERRE FABRE) * Claims 1-5 * -------	1,10	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

C 07 C 65/00

INCOMPLETE SEARCH

The Search Division considers that the present European patent application does not comply with the provisions of the European Patent Convention to such an extent that it is not possible to carry out a meaningful search into the state of the art on the basis of some of the claims.

Claims searched completely:

Claims searched incompletely: 1-8,10,11

Claims not searched: 9

Reason for the limitation of the search: Method for treatment of the human or animal body by surgery or therapy (see art. 52(4) of the European Patent Convention)

Place of search	Date of completion of the search	Examiner
The Hague	02-10-1985	KLAG

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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X	FR-A- 2 172 868 (PIERRE FABRE) * Claims 1-5 *	1,10	

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L : document cited for other reasons

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European Patent Office

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

☐ All claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claims:

☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

X LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirement of unity of invention and relates to several inventions or groups of inventions.

namely: 1) Claims 1,3,8,10,11: In case X is a group $-\overset{\overset{O}{\|}}{C}-\overset{\overset{R_7}{|}}{C}=CR_8$ or $-CR_8=\overset{\overset{R_7}{|}}{C}-\overset{\overset{O}{\|}}{C}-$

2) Claims 1,2,4,7,8,10,11: In case X is a group $-N(R_7)-\overset{\overset{O}{\|}}{C}-$ or $-\overset{\overset{O}{\|}}{C}-N(R_7)-$

3) Claims 1,6,8,10,11: In case X is a group $-C(R_7)-C(R_8)-$ (O)

4) Claims 1,5,8,10,11: In case X is a group $-N=N-$

5) Claims 1,8,10,11: In case X is a group $-\overset{\overset{-O}{|}}{{}^{+}N}=N-$ or $-N=\overset{\overset{O-}{|}}{N^{+}}-$

☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.

☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:

☒ None of the further search fees has been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims: 1,3,8,10,11 (under point 1)